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Post-Construction Monitoring at the Genesis Solar Energy Project Riverside County, California

2015 Summer Quarterly Interim Report

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EXECUTIVE SUMMARY

Avian and bat monitoring surveys were conducted from June 01 to August 30, 2015 (the summer season; for logistical reasons, fall monitoring started on Monday, August 31, 2015) at Genesis Solar Energy Project (Project) in accordance with the Project's Bird and Bat Conservation Strategy (BBCS). Specifically, standardized carcass searches, searcher efficiency trials, and carcass persistence trials were conducted. This report represents the second seasonal report for the first year of monitoring, and summarizes monitoring methods and results for those surveys based on the procedures and requirements specified in the BBCS. This report and the other interim quarterly reports are considered preliminary summaries of data and information for the seasonal monitoring periods. Final information from all four quarterly monitoring periods will be included in a comprehensive final annual report.

Standardized carcass searches were conducted 1) in the solar field, consisting of a random stratified 30% sample of solar troughs of both Project units, 2) at each evaporation pond, 3) along the perimeter of each power block and beneath each air condensed cooling (ACC) unit, 4) along inner and outer portions of the "fenceline", resulting in 100% of the length of the perimeter fence surveyed, and 5) along 25% of the total length of generation-tie (gen-tie) and distribution lines (collectively, overhead lines) from the southernmost Project fence to Wiley's Well reststop, which co-occur with the Project access road. Searches were conducted within the summer season at intervals of approximately 21 days, and all components were searched four times. All searches took place during daylight hours from approximately 06:30 to 17:00.

All bird and bat fatalities and injuries that were discovered by observers, referred to as "detections" in this report, including those found incidentally and during standardized carcass searches, were documented. During the reporting period, 55 avian detections and five bat detections were made.

According to specifications of the BBCS, avian detections were categorized by likely diurnal or nocturnal migration behavior, ecological guild (e.g., raptors, songbirds, etc.), facility component, and suspected cause of death. These standardized carcass search results, along with searcher efficiency and carcass persistence rates from bias trials conducted on site, were input into a fatality estimator model (Huso 2010) to provide a preliminary estimate of the number of fatalities that occurred at the Project during the reporting period adjusted for sources of bias. The estimate is considered preliminary because the annual report may pool information from bias trials and other data across seasons which could affect seasonal estimates.

Carcass persistence was influenced by Project component, carcass size, and, in the solar field (solar collector assemblies + perimeter fence), season. In the solar field, small carcasses (0-100 g) had a 52% (90% confidence interval [CI]: 45 – 64%) chance of persisting through the 21-day search interval, medium carcasses (101 – 999 g) had an 92% (90% CI: 76 – 96%) chance, and large carcasses (1000+ g) had a 100% chance. Mean (median) removal time in the solar field was 8.0 (9.0) and 35.1 (30.0) days for small and medium carcasses, respectively. Mean and

median removal times for large carcasses in the solar field were not estimated because no removal of large carcasses was observed. Along overhead lines, small carcasses had a 14% (90% CI: 9 – 20%) chance of persisting through the 21-day search interval, medium carcasses had a 59% (90% CI: 42 – 74%) chance, and large carcasses had a 41% (90% CI: 26 – 58%) chance. Mean (median) removal time along overhead lines for small, medium, and large carcasses was 0.8 (0.5), 12.8 (30.0), and 4.6 (3.5) days, respectively. The difference in carcass removal times between Project components is because scavengers likely occur in higher densities outside the perimeter fence.

In the solar field, searcher efficiency averaged over all observers was 92% (86 – 98%) and there was no effect of carcass size, visibility class, or season (n =). Along overhead lines, searcher efficiency averaged over all observers was influenced by carcass size: 54% (90% CI: 39 – 68%) for small birds, 100% for medium birds, and 100% for large birds (n =).

Composition of summer detections included species from 13 avian guilds. No single guild comprised a large number of detections: the most common was blackbirds/orioles (eight detections). Shorebirds and waterbirds/waterfowl were represented by six and seven detections, respectively. Summer was the first season in which bats were detected.

Using the Huso (2010) fatality estimator model, during the summer period 2015, there were an estimated total 100 carcasses (90% CI: 81 - 145) at the Project. Of these, 53 carcasses (53%) were estimated for the SCAs, 8 carcasses (8%) were estimated for the fence, 9 carcasses (9%) were estimated for evaporation ponds, 23 carcasses (23%) were estimated for power blocks, and 7 carcasses (7%; 90% CI: 6 - 21) were estimated for the overhead lines and project road. An estimated 93 (93% CI: 66 - 126) carcasses (50/1000 acres, 0.37/nameplate MW) occurred for all components associated with both solar units (SCAs, power block, evaporation ponds, and along the perimeter fence, combined).

STUDY PARTICIPANTS

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REPORT REFERENCE

Western Ecosystems Technology, Inc. (WEST). 2015. Post-construction monitoring at the Genesis Solar Energy Project, Riverside County, California. 2015 Summer Report. 32 pp.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1.0 INTRODUCTION 4
1.1 Project Background 4
1.2 Monitoring Plan Overview and Goals 4
1.3 Purpose of This Report 4
2.0 METHODS 7
2.1 Standardized Carcass Searches 7
2.1.1 Areas Surveyed 7
2.1.2 Search Frequency and Timing 7
2.1.3 Search Methods 12
2.2 Carcass Persistence Trials 13
2.2.1 Carcass Persistence Data Collection 13
2.2.2 Estimating Carcass Persistence Times 14
2.3 Searcher Efficiency Trials 14
2.3.1 Searcher Efficiency Data Collection 14
2.3.2 Estimating Searcher Efficiency 15
2.4 Fatality Estimator 16
2.5 Incidental Reporting 16
3.0 MONITORING RESULTS 17
3.1 Summary of Avian Detections 17
3.2 Temporal Patterns of Avian Detections 20
3.3 Spatial Distribution of Avian Detections 22
3.3.1 Detections by Project Component 22
3.3.2 Feather Spot Detections 23
3.4 Detections of Stranded Birds 23
3.5 Summary of Bat Detections 23
3.6 Carcass Persistence Trials 23
3.7 Searcher Efficiency Trials 26
3.8 Fatality Estimates 27
4.0 DISCUSSION 28
4.1 Carcass Persistence and Searcher Efficiency Trials 28
4.2 Distribution of Fatalities and Fatality Estimates 29
5.0 LITERATURE CITED 31

LIST OF TABLES

Table 1. Areas included in standardized carcass searches at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015. 10

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector trough. 18

Table 3. Total detections by Project component and detection category during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. 22

Table 4. Total detections (including incidentals) by Project component and suspected cause of death during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. 22

Table 5. Searcher efficiency trial carcass locations by Project component during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. 26

Table 6. Status of detections during the summer (June 01 – August 30) 2015 season at the Genesis Solar Energy Project, Riverside County, California. All detections outside the search area were excluded from the fatality analysis, regardless of whether they occurred during a standardized carcass search or incidentally. 27

LIST OF FIGURES

Figure 1. Genesis Solar Energy Project vicinity map, Riverside County, California. 6

Figure 2. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 1 of the Genesis Solar Energy Project summer (June 01 – August 30) 2015. 8

Figure 3. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 2 of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015. 9

Figure 4. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance activities) along the distribution and generation tie lines and Project access road at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015. Detailed maps of detections are presented in Appendix C. 11

Figure 5. Total number of detections by date during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. 21

Figure 6. Proportion of trial carcasses remaining as a function of days since placement and carcass size class during the summer 2015 season at the Genesis Solar Energy Project, Riverside County, California. Modeling of carcass persistence data from overhead lines suggested no effect of season, so sample size used to produce the overhead lines panel was n = 30, 20, and 10 for small, medium, and large size classes, respectively. Modeling of carcass persistence data from the solar field (SCAs) suggested an effect of season, so sample size used to produce the SCA panel was n = 15, 10, and 5 for small, medium, and large size classes, respectively. 25

LIST OF APPENDICES

Appendix A. Weather Conditions and Body Weights Associated with Avian Detections Estimated to be Less Than 24 Hours Old during summer (June 01 – August 30) 2015

Appendix B. Correction Factors and Bird Fatality Rates at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Appendix C. Detailed Areas of Standardized Searches and Carcass Locations along the Distribution and Generation Tie Lines of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Appendix D. Individual detections made during standardized carcass searches and incidentally, by species, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector trough.

1.0 INTRODUCTION

1.1 Project Background

The Genesis Solar Energy Project (referred to in this report as "Project") consists of two solar power electrical generating facilities (Units 1 and 2) with a combined net capacity of 250 megawatts. The Project facility consists collectively of two power blocks, power generating equipment (solar collector assemblies [SCAs] of mirrored parabolic troughs [solar troughs or troughs]), support facilities, and evaporation ponds. Linear facilities include a transmission line, distribution line, natural gas pipeline, and a main access road that are mostly co-located for approximately 10.5 km (6.5 miles). The Project comprises approximately 1,800 acres (728 hectares [ha]). The solar field and associated structures comprise 1,727 acres (699 ha) and linear facilities comprise 93 acres (38 ha). The Project is located on land managed by the Bureau of Land Management (BLM) 25 miles (40 kilometers [km]) west of Blythe, in Riverside County, California (Figure 1).

1.2 Monitoring Plan Overview and Goals

A Bird and Bat Conservation Strategy (2015; "BBCS") was prepared by the Project proponent in collaboration with the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), California Energy Commission (CEC), and Bureau of Land Management (BLM) to guide comprehensive monitoring of impacts to birds and bats associated with operation of the Project. Final agency acceptance of the BBCS occurred in March 2015.

The BBCS details post-construction monitoring to be conducted and the data analysis and reporting processes that will be implemented by Genesis Solar in collaboration with the USFWS, CDFW, CEC, and BLM. As identified in the BBCS, they are:

1. Estimate overall annual avian fatality rate and species composition associated with the Project infrastructure. This estimate will include mortality associated with SCAs, overhead lines including the generation (gen-tie) line, perimeter fence and other features of the Project that may result in injury and fatality.
2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with project infrastructure (e.g., different fatality rates near SCAs on the edge of the solar field versus the interior area of the solar field).
3. Provide information that will assist the CEC and BLM, in consultation with the USFWS and the CDFW, in understanding which species and potentially which regional populations are at risk.
4. Collect data in such a way that the CEC and BLM, in consultation with the USFWS and CDFW, may make comparisons with other solar sites.

1.3 Purpose of This Report

This report represents the second seasonal report for the first year of monitoring summarizing monitoring methods and results for avian and bat fatalities and injuries based on the procedures and requirements specified in the approved BBCS and as required by CEC Condition of Certification BIO-16. This report covers the 2015 summer season, which includes the period from June 01 to August 30, 2015. For logistical reasons, fall monitoring started on Monday, August 31, 2015. This report and the other interim quarterly reports are considered preliminary summaries of data and information for the seasonal monitoring periods. Final information from all four quarterly monitoring periods will be included in a comprehensive final annual report. As stated in the approved BBCS, this seasonal report includes the observed fatality rates broken out by likely diurnal, and likely nocturnal species, and for ecological guilds of interest (e.g., raptors, water-associated birds, passerines), for each of the facility types and suspected causes of death. Species composition of carcasses and the results of the bias trials are also reported. This report presents information related to the spatial distribution of carcasses, but no formal statistical analysis will be conducted until the end of the monitoring year, given the limited data presently available.

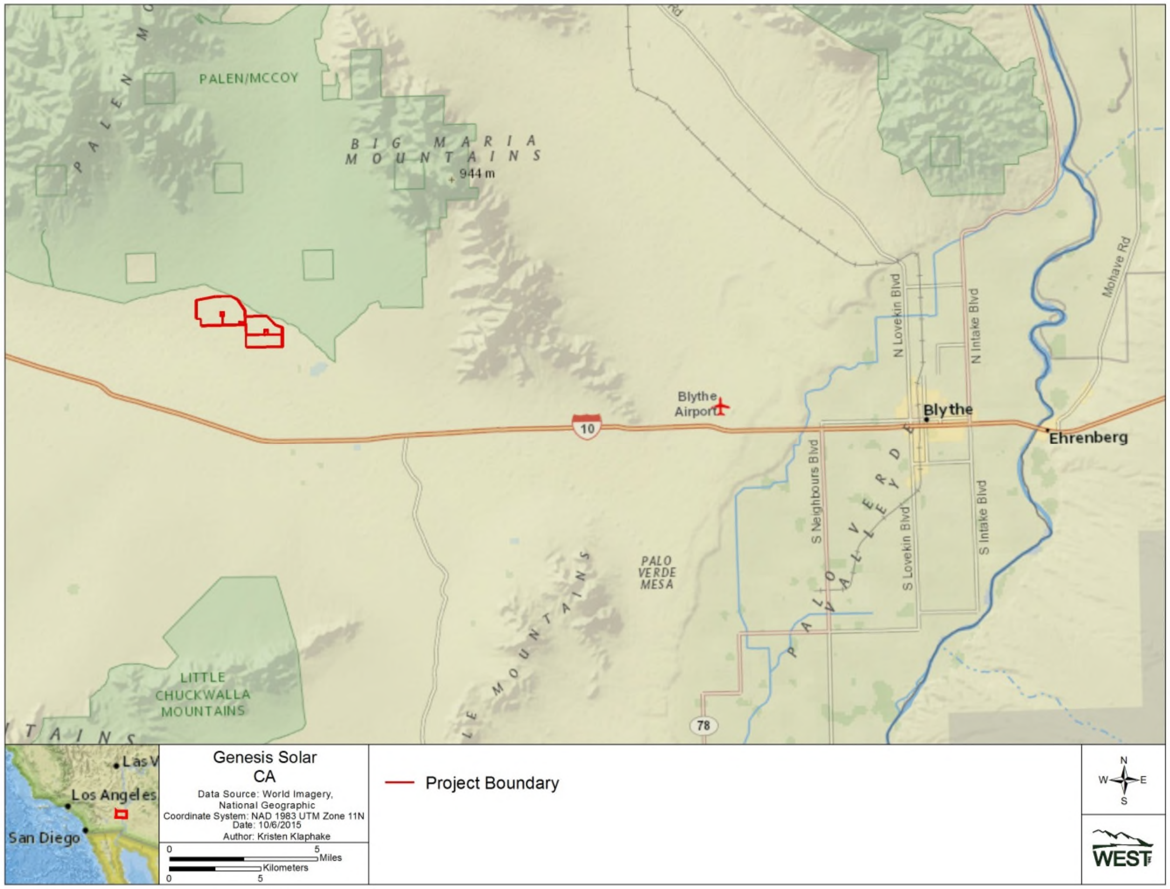

Figure 1. Genesis Solar Energy Project vicinity map, Riverside County, California.

2.0 METHODS

The BBCS describes the methods by which monitoring and certain analyses, including compilation of the overall fatality estimate, will occur. Below is an abridged description (see BBCS for detailed methods).

2.1 Standardized Carcass Searches

This section describes areas surveyed, the timing and frequency of searches, and the methods by which standardized searches were conducted to identify dead/injured birds and bats at the Project. This section also describes the methods for conducting carcass removal and searcher efficiency trials; how data were reported and analyzed; and the methods for producing fatality estimates for the Project.

2.1.1 Areas Surveyed

Standardized carcass searches were conducted at a sample of the solar collector assemblies in each unit; the perimeter of each power block (including the area below each air condensed cooling [ACC] unit; Figures 2 and 3); the "fenceline" defined as the perimeter fences for each unit (100% of the total length of fence; Figures 2 and 3); and the gen-tie and distribution lines (25% of the total length of each line from the Project fence to Wiley's Well rest stop; Figure 4). Table 1 provides the total area of each component as well as the percent of each component that was searched.

To ensure a balanced distribution of plots in solar collector assemblies, each unit was divided into blocks, and each block was sampled using a systematic sample of 30% of pairs of rows with a random starting point. This sampling design ensures that survey plots were not spatially clumped.

2.1.2 Search Frequency and Timing

The summer survey season includes the period from June 01 through August 30, 2015. Standardized searches occurred at 21-day intervals beginning June 01, 2015. All project components included in standardized searches were surveyed four times. All searches took place during daylight hours from 06:30 to 17:00.

The average summer search interval was 18.9 days (median 21 days) for all Project components included in standardized carcass searches. Slight variation in search interval was anticipated due to weather and logistical delays.

Figure 2. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 1 of the Genesis Solar Energy Project summer (June 01 – August 30) 2015.

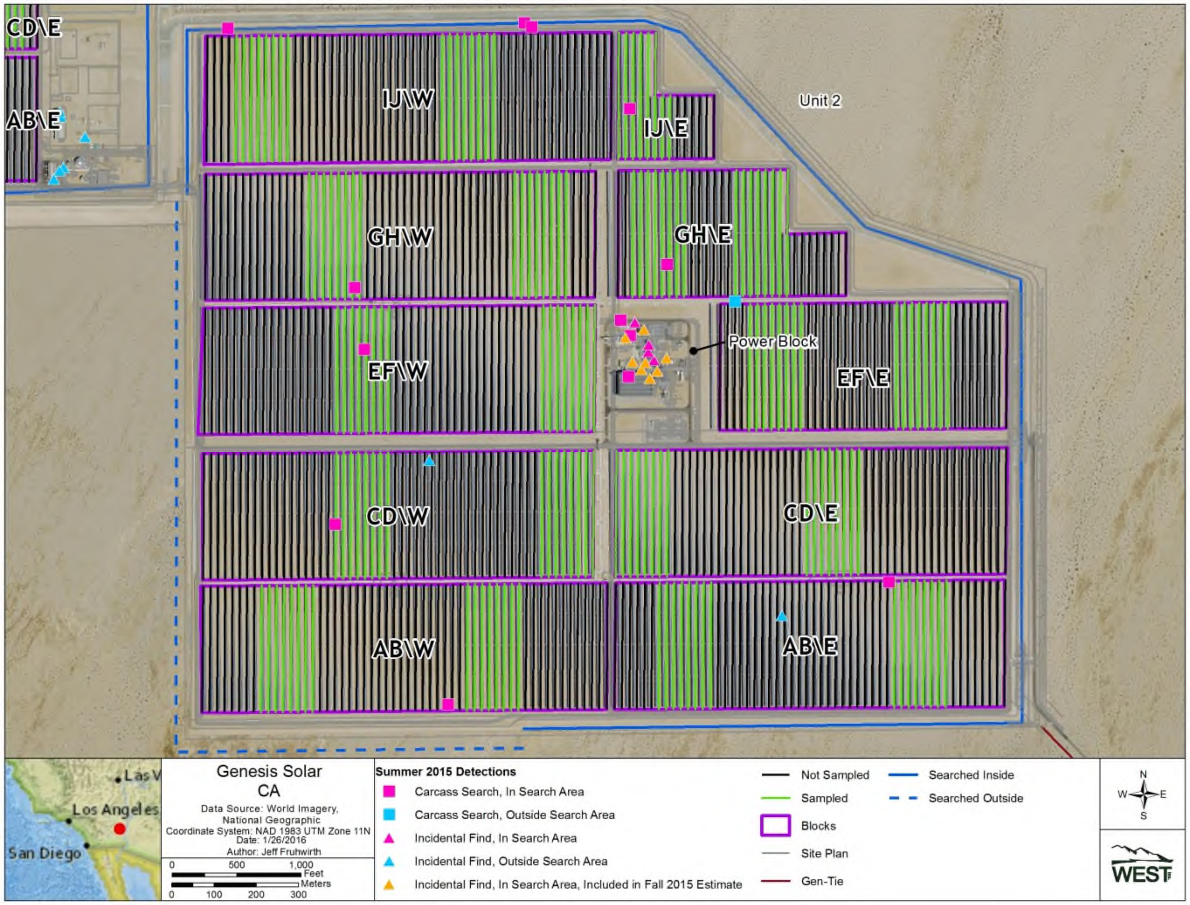

Figure 3. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 2 of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Table 1. Areas included in standardized carcass searches at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Project Component	Total Size	Units	Percent of Component Searched
SCAs	920	rows of solar troughs	30.4
Unit 1	460	rows of solar troughs	27.8
Unit 2	460	rows of solar troughs	33.0
ACC units	0.9	hectares	100
Power block (perimeter)	0.8	kilometers	100 of perimeter
Evaporation ponds	3.1	hectares	100
Distribution line	8.4	kilometers	25.0
Generation Tie line	8.4	kilometers	25.0
Fence	14.5	kilometers	100

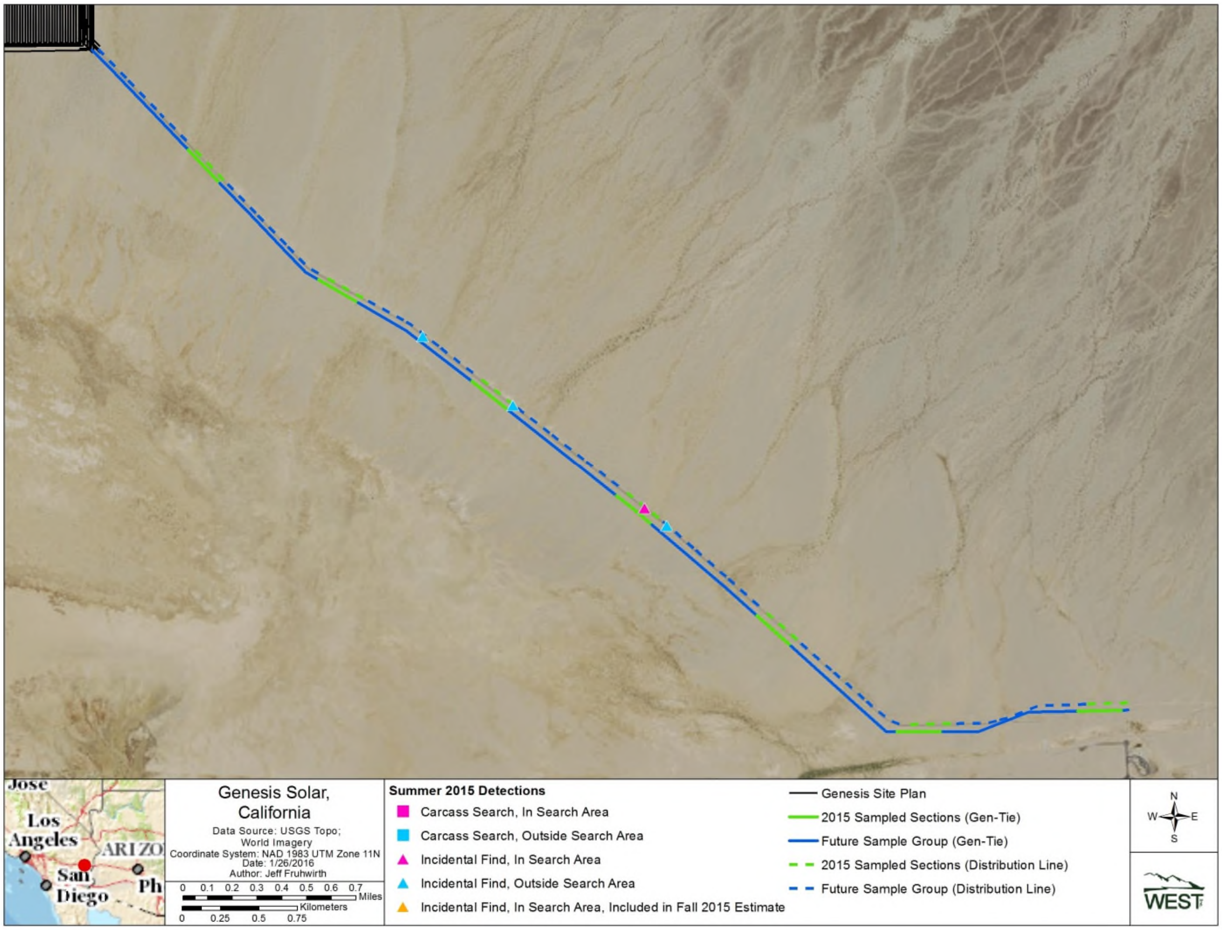

Figure 4. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance activities) along the distribution and generation tie lines and Project access road at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015. Detailed maps of detections are presented in Appendix C.

2.1.3 Search Methods

Standardized carcass searches were performed by CEC- and BLM-approved biologists, in accordance with methods outlined in the BBCS.

Within the solar collector assemblies, 280 solar troughs (30.4% of the total number of troughs) were surveyed by vehicle. Biologists slowly drove (≤5 mph) parallel to troughs and centered between rows, searching ahead and to the driver's side of the vehicle for bird and bat carcasses. Biologists scanned out to a perpendicular distance of approximately 30 m, or the ground area encompassing two rows of solar troughs.

At each power block, biologists slowly walked around the entire perimeter looking for dead and injured birds and bats, and used binoculars to scan interior portions of the powerblock. Per site safety rules, the biologists are not allowed to walk in the interior of the powerblock. However, site personnel do safety inspections and other maintenance on a daily basis within the powerblock. Correction factors for the powerblock Beneath ACC units, biologists walked four evenly-spaced transects (approx. 15-m apart) through the gravel. The search area for the power block is defined as the 0.8-km perimeter of each power block, and the area of the interior power block that was available for visual inspection from the periphery.

At each evaporation pond, biologists walked the entire perimeter looking for dead and injured birds and bats on the ground, in the netting, and in the pond below the netting. Binoculars or a spotting scope were used to scan across the top of the netting and the surface of each pond.

The entire length of fenceline (approximately 12 miles) was searched by vehicle. Biologists searched an approximately 1.5 to 2.5 miles (2.4 km) along drivable sections of the outside of the fence, and the remaining 9.5 to 10.5 miles (16.9 km) were surveyed from the inside of the fence (Figures 2 and 3). Travel speed was below five mph while searching.

The gen-tie and distribution lines were each surveyed using a 30-m wide strip transect (i.e., 15 m of ground on either side of the overhead line). A 25% sample of both lines from the Project fence to the Project outer gate located near the Wiley's Well Road rest stop were searched for carcasses. Biologists slowly walked every fourth 300-ft segment of each line, scanning for dead or injured birds or bats within 15 m (49.2 ft) of the transect line. Given the location of the lines relative to the road, detections found in the strip transects below overhead lines could be caused by collision with an overhead line, vehicles along the road, or some combination of both.

As soon as a carcass was detected, it was then photographed, and data were recorded according to specifications outlined in section 6.7 of the approved Genesis BBCS. Carcasses were then immediately retrieved from their location on the ground, labeled, and placed in a freezer on site.

Suspected cause of death was assigned based on evidence available on the detection, evidence available on the Project infrastructure, and proximity of a detection to Project infrastructure. Detections that had evidence of scavenging and lacked evidence on Project infrastructure were assigned as “unknown” because it can’t be determined whether the event was caused by predation or interaction with project infrastructure. Detections that were intact (i.e., no evidence of scavenging), located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines), and had evidence of injury on the detection had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed.

2.2 Carcass Persistence Trials

Carcass persistence trials were conducted throughout the summer period. Carcasses from three size classes (small [0-100 g], medium [101-999], and large [1000+ g]) were used for trials. Carcass persistence results from small birds were used as a proxy for bat carcass persistence. The small size class comprised house sparrows (*Passer domesticus*) and 2-3 week old coturnix quail (*Coturnix coturnix*), the medium size class comprised rock pigeons (*Columba livia*), chukar (*Alectoris chukar*) and older coturnix quail, and the large size class comprised hen mallard (*Anas platyrhynchos*) and hen ring-necked pheasant (*Phasianus colchicus*).

2.2.1 Carcass Persistence Data Collection

To quantify carcass persistence rates, 15 small, 10 medium, and five large carcasses were randomly placed and monitored within the solar field (SCA’s and the fence line), and the same number of each size class were placed along the gen-tie and distribution lines, for a total of 60 carcass persistence trials at Genesis during the summer 2015 season, as specified in section 6.5 of the approved Genesis BBCS. Fifteen carcasses within the Project fence (within SCAs and along the fence and perimeter of power blocks) and four carcasses along the gen-tie and distribution lines were monitored using motion-triggered digital trail cameras, while the remaining carcasses were visited on foot, for 30 days or until the carcass had deteriorated to a condition at which it would no longer qualify as a documentable fatality (i.e., a feather spot). Fewer carcasses along the gen-tie and distribution lines were monitored with cameras because of theft and vandalism concerns. Carcasses without trail cameras were visited and photographed once per day for the first four days, and then every three to five days until the end of the monitoring period. To avoid training scavengers to recognize cameras as “feeding stations”, trail cameras were installed five days before specimens were placed, and fake cameras without bias trial carcasses were also placed (eight within the Project fence, and four along the gen-tie and distribution lines). Periodic ground-based checking of carcasses with trail cameras also occured to guard against misleading indicators of carcass removal, such as wind blowing the carcass out of the camera’s field of view. To minimize potential bias caused by scavenger swamping (Smallwood 2007, Smallwood et al. 2010), carcass-persistence specimens were distributed across the entire Project, not just in areas subject to standard searches, and trials were initiated in small numbers on four different dates throughout the spring season.

2.2.2 Estimating Carcass Persistence Times

Carcass persistence trials were checked daily during the first four days and then every three to five days until the 30-day trial length was reached. Measurements of carcass persistence rates were subject to censoring. In this context, censoring refers to the instance when a value (e.g. days a carcass is present before being removed) may not be known exactly, but is known to be within a finite range. For example, suppose a carcass was checked on day 7 and was present, and was checked again on day 10, but was found to be missing. The exact time until removal is unknown; however, it is known that the carcass became unavailable at some point between 7 and 10 days. This carcass would be considered "interval censored". Similarly, if a carcass lasts the entire 30-day trial period, that carcass is "right censored"— it is known that the carcass lasted at least 30 days, but it may have persisted longer. Because carcass persistence data were censored, persistence was analyzed using methods that can accommodate censored data and still produce unbiased estimates of the probability of persistence (Therneau 2015, Thernaur and Grambsch 2000). It is beyond the scope of this document to provide statistical foundations of censored-data survival models but functions identical to those provided with the USGS-developed fatality estimator software (Huso et al 2012) were used to fit survival models to the censored carcass persistence data, and some background is available in the documentation provided with that software.

USGS-developed fatality estimator software (Huso et al. 2012) was used to fit survival models to the censored carcass persistence data. There were four distributions implemented in survival models used to estimate the probability a carcass is unscavenged and available to be found at the end of the search interval (*r)*: exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying degrees of flexibility in order to model a wide variety of distributions of persistence time. Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model to censored carcass persistence data.

2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the summer period. Carcasses from three size classes (small, medium, and large) were used for trials. Searcher efficiency results from small birds were used as a proxy for bat detection. The small size class comprised house sparrows and 2-3 week old coturnix quail, the medium size class comprised rock pigeons, chukar, and older coturnix quail, and the large size class comprised hen mallards and hen ring-necked pheasants.

2.3.1 Searcher Efficiency Data Collection

A total of 60 searcher efficiency trials (15 small birds, 10 medium birds, and five large birds within SCA's, power blocks, and along the perimeter fence, and the same number of each size class along the gen-tie and distribution lines) were placed at the Project during the 2015 summer season, as specified in section 6.4 of the approved Genesis BBCS. Locations for trials were chosen by taking a randomized sample of all locations included in standardized carcass searches. Trial carcasses were placed in various vegetation heights and in areas that had different soil and vegetation colors and values to represent the range of conditions under which searches occur. They were placed in all areas where standardized searches occur except the evaporation ponds. Trial carcasses were placed in selected search areas the same morning that a search is scheduled to occur in that area. Trial carcasses were retrieved the same day, either by the searcher who found them, or for missed carcasses, by the observer who conducted the searcher efficiency trial.

2.3.2 Estimating Searcher Efficiency

There were not sufficient data for the summer season to assess whether searcher efficiency differed by Project component (e.g., SCAs/fence/power block [solar field] versus gen-tie/distribution line [overhead lines]), so searcher efficiency was assumed to differ between the two areas and was estimated separately for the solar field and overhead lines. The nearly complete lack of vegetation cover in the solar field suggests that searcher efficiency may be higher in the solar field than along the overhead lines where vegetation cover is greater. If this hypothesis is true, accounting for this difference in searcher efficiency across Project components will be important for producing accurate fatality estimates at the end of the monitoring year.

To evaluate hypotheses regarding differences in carcass detectability among carcass size and visibility classes, logistic regression models were fit to searcher efficiency data and AICc was used to compare models. Models including effects of carcass size (3 classes), season (spring, summer) and visibility index (2 classes) were compared to each other and a null model. The two visibility classes present at the Project site are: easy (defined as ≥ 90% bare ground [BG]; vegetation <6" tall) and moderate (defined as 26-89% BG; vegetation <6" tall). However, within the solar field the moderate visibility class has a very limited spatial extent (approximately 10%) due to management aimed at minimizing vegetation cover and thus, was represented by only two trial carcasses during the reporting period. Rather than eliminating the two carcasses in the moderate class from the analysis of searcher efficiency, we assumed there were no differences in searcher efficiency between the two visibility classes in the solar field this summer, and the set of candidate models for searcher efficiency (within the solar field only) did not include tests of the hypothesis that searcher efficiency varied between visibility classes. The spatial extent of the moderate visibility class in the solar field is roughly equal to its representation in the summer sample of searcher efficiency carcasses (8 of 60 or 13.3%).

Once the best model was chosen and appropriate classes identified, searcher efficiency, or the proportion of carcasses detected, *p,* was calculated for each class using the following equation:

$$p = \frac{Number\ of\ Carcasses\ Observed}{Number\ of\ Carcasses\ Available}$$

The data for this analysis included all searcher efficiency trial carcasses from the spring and summer 2015 season, because model selection results indicated no differences in searcher efficiency by season.

2.4 Fatality Estimator

Fatality rate estimation is a complex task due to several variables inherent to every fatality monitoring study. Carcasses may persist for variable amounts of time due to local scavenger activity or environmental conditions leading to carcass degradation over time. Carcasses and feather spots are also detected with varying levels of success based on carcass characteristics and ground cover (e.g., vegetated areas underneath the gen-tie and distribution lines versus cleared areas beneath SCAs). For these reasons, it is generally inappropriate to draw conclusions based on the raw number of fatalities alone. The desire to estimate fatalities given these variables has driven the development of several statistical methods for estimating fatalities (e.g., Smallwood 2007, Huso 2010, Korner-Nievergelt 2011). All of these fatality estimation methods share a similar underlying model. Generally, the fatality estimation for a given site may be written as:

$$F=C/rp,$$

where F is the total number of fatalities, C is the number fatalities detected and included in fatality estimation, r is the probability a carcass is unscavenged and available to be found at the end of the search interval, and p is the probability of detecting a carcass (Huso 2010).

All fatality estimates were calculated using the Huso estimator, as well as 90% confidence using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates were used for each variable including searcher efficiency (p), probability of a carcass persisting to the next search ($\hat{r}$), adjusted search interval and observed fatalities. From these bootstraps, the probability of available and detected was calculated and applied to the bootstrapped observed fatalities. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates provide estimates of the lower limit and upper limit of an approximate 90% confidence interval on all estimates.

2.5 Incidental Reporting

Some detections were outside standardized search areas, or were within search areas but not observed during standardized searches. Such detections were found by WEST avian biologists and operational personnel and were considered “incidental” detections. When found by operational personnel, these detections were reported to WEST avian biologists for documentation. Data on incidental detections are reported here, as well as in the SPUT Avian Injury and Mortality Report Forms June – August 2015. All detections made in search areas were included in fatality estimates, regardless of whether they were detected incidentally or during searches.

3.0 MONITORING RESULTS

3.1 Summary of Avian Detections

During summer 2015, a total of 60 detections (including stranded birds, incidental detections, and bats) of 32 identified species were recorded (Table 2). The most numerous detection of an identified species was of brown-headed cowbird (*Molothrus ater*), and greater roadrunner (*Geococcyx californianus*), each with five detections. Most detections (n = 22, or 36.7% of total detections) occurred at powerblocks (Figures 2, 3; Tables 2, 3, and 4). Twenty-four (40.0%) detections were made during standardized carcass searches and 36 (60.0%) were documented as incidentals with most of these (n = 17) in the powerblock.

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector trough.

Common Name	Scientific Name	SCA	Powerblock	Ponds	Fence	Gen-tie line	Other	Total Count
Avian								
brown-headed cowbird	*Molothrus ater*	2	2	-	-	-	1	5
greater roadrunner	*Geococcyx californianus*	1	3	-	-	1	-	5
unidentified bird (small)	-	3	1	-	1	-	-	5
mourning dove	*Zenaida macroura*	-	1	-	-	2	-	3
unidentified bird (unknown size)	-	1	1	-	1	-	-	3
cinnamon teal	*Anas cyanoptera*	1	-	1	-	-	-	2
red-winged blackbird	Agelaius phoeniceus	1	-	-	1	-	-	2
unidentified duck	-	2	-	-	-	-	-	2
white-winged dove	*Zenaida asiatica*	-	2	-	-	-	-	2
American kestrel	*Falco sparverius*	-	1	-	-	-	-	1
bank swallow	*Riparia riparia*	-	1	-	-	-	-	1
belted kingfisher	*Ceryle alcyon*	-	1	-	-	-	-	1
black phoebe	*Sayornis nigricans*	-	1	-	-	-	-	1
California gull	*Larus californicus*	1	-	-	-	-	-	1
cliff swallow	*Petrochelidon pyrrhonota*	-	1	-	-	-	-	1
common nighthawk	*Chordeiles minor*	-	-	1	-	-	-	1
eared grebe	*Podiceps nigricollis*	-	-	1	-	-	-	1
Eurasian collared-dove	*Streptopelia decaocto*	-	-	-	-	-	1	1
Gambel's quail	*Callipepla gambelii*	-	-	-	1	-	-	1
lesser nighthawk	*Chordeiles acutipennis*	-	-	-	-	1	-	1
loggerhead shrike	*Lanius ludovicianus*	1	-	-	-	-	-	1
long-billed curlew	*Numenius americanus*	1	-	-	-	-	-	1
ruddy duck	*Oxyura jamaicensis*	-	-	1	-	-	-	1
snowy egret	*Egretta thula*	-	1	-	-	-	-	1

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector trough.

Common Name	Scientific Name	SCA	Powerblock	Ponds	Fence	Gen-tie line	Other	Total Count
spotted sandpiper	*Actitis macularia*	1	-	-	-	-	-	1
Townsend's warbler	*Setophaga townsendi*	-	1	-	-	-	-	1
tree swallow	*Tachycineta bicolor*	-	-	1	-	-	-	1
unidentified bird (medium)	-	-	-	1	-	-	-	1
unidentified sandpiper	-	-	1	-	-	-	-	1
western gull	*Larus occidentalis*	1	-	-	-	-	-	1
western kingbird	*Tyrannus verticalis*	-	-	-	-	-	1	1
western sandpiper	*Calidris mauri*	-	-	1	-	-	-	1
yellow-billed cuckoo	*Coccyzus americanus*	-	1	-	-	-	-	1
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-	-	1	-	-	-	1
yellow warbler	*Setophaga petechia*	-	-	-	-	-	1	1
Bats								
canyon bat	*Pipistrellus hesperus*	-	-	-	-	-	2	2
unidentified bat	-	-	2	-	-	-	-	2
Mexican free-tailed bat	*Tadarida brasiliensis*	-	1	-	-	-	-	1
Total		16	22	8	4	4	6	60

3.2 Temporal Patterns of Avian Detections

The number of detections recorded daily during summer 2015 ranged from zero to five (Figure 5). The period from June 01 to August 30 was characterized by peaks in detections with highs on June 29, July 2, and August 17. The fewest detections in any calendar month was July. The number of detections per day represents those discovered during standardized carcass searches and incidentally.

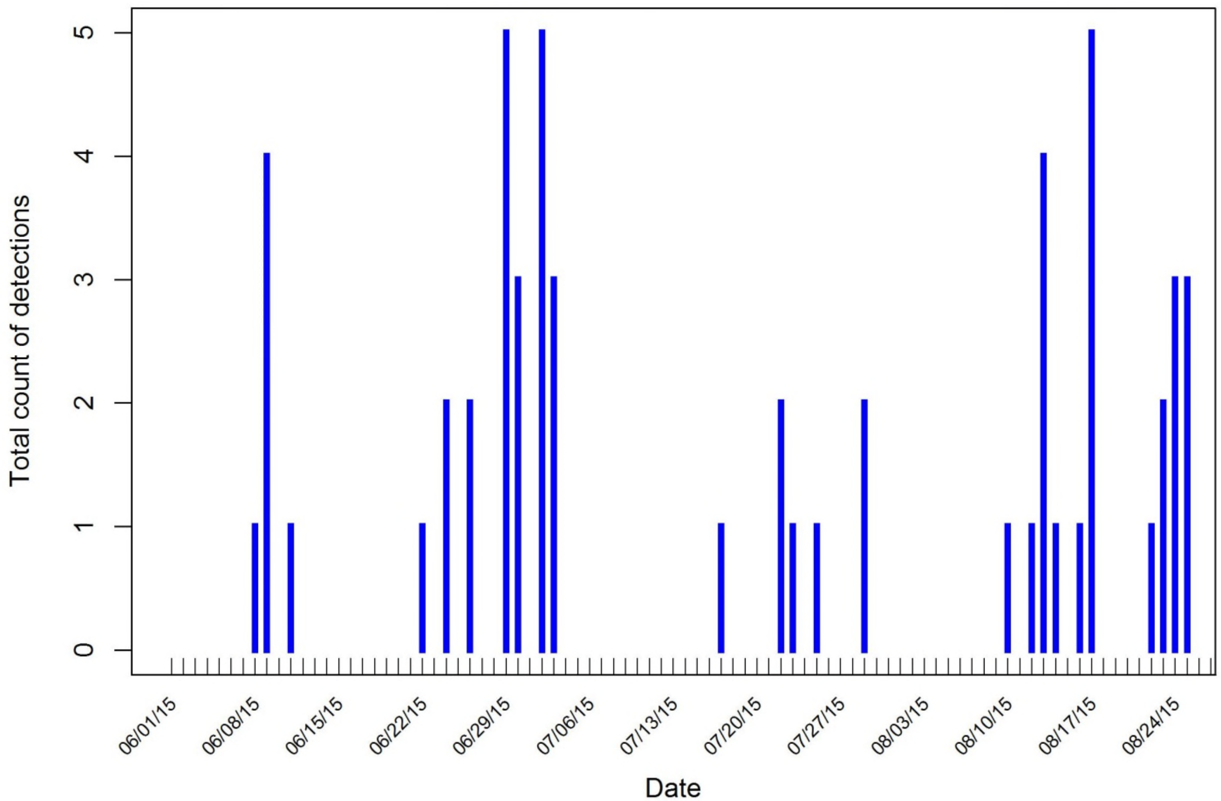

Figure 5. Total number of detections by date during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California.

3.3 Spatial Distribution of Avian Detections

3.3.1 Detections by Project Component

During summer 2015, detections were documented from Project buildings, the perimeter fence, gen-tie and distribution lines (overhead lines), the power block or ACC unit within the power block, evaporation ponds, and SCAs (Tables 2, 3, and 4). Of the 56 detections within the solar units, 27 (48.2%) were detected in Unit 1, and 29 (51.8%) were detected in Unit 2.

Table 3. Total detections by Project component and detection category during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Carcass search	Incidental	Percent of Total
Buildings	0	6	10.0
Fence	4	0	6.7
Overhead lines	0	4	6.7
Ponds	5	3	13.3
Power Block	5	17	36.7
SCA	10	6	26.7
Percent of Total	40.0	60.0	100.0

Table 4. Total detections (including incidentals) by Project component and suspected cause of death during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California.

	Suspected Cause of Death*						
Project Component	**Collision**	**Drowned**	**Entangled**	**Other**	**Predation**	**Unknown**	**% of Total**
Fence	0	0	0	2	0	2	6.7
Other	1	0	0	1	0	4	10.0
Overhead lines/road	2	0	0	1	0	1	6.7
Pond	1	0	2	3	0	2	13.3
Powerblock	7	1	0	8	0	6	36.7
SCA	4	0	0	8	1	3	26.7
% of Total	25.0	1.7	3.3	38.3	1.7	30.0	100.0

* Suspected cause of death was assigned based on evidence available on the detection, evidence available on Project infrastructure, and proximity of detection to Project infrastructure. Detections that had evidence of scavenging and lacked evidence on Project infrastructure were assigned as “unknown” because it can’t be determined whether the event was caused by predation or interaction with project infrastructure. Detections that were intact (i.e., no evidence of scavenging) and located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines) and had evidence of injury on the detection had a suspected cause of death attributed to the respective Project component. However, in the absence of completed necropsy, there is some uncertainy associated with cause of death assignments because no events were directly observed.

3.3.2 Feather Spot Detections

Twelve (20.0%) of the 60 detections made during summer 2015 consisted only of feather spots. Along the fence, three of four total detections (75.0%) were feather spots. No detections along the overhead lines and road or the evaporation ponds were feather spots. Three of 22 total detections (13.6%) at the powerblocks were feather spots. Six of 16 total detections (37.5%) at SCA's were feather spots.

3.4 Detections of Stranded Birds

There were no detections of stranded or injured birds during the 2015 summer season.

3.5 Summary of Bat Detections

Five bats were detected during the summer season. Idenitified species included Mexican free-tailed (*Tadarida brasilinesis*; 1), and canyon bat (*Pipistrellus hesperus*; 2; Table 2).

3.6 Carcass Persistence Trials

Data from carcass persistence trial carcasses were available from spring and summer at the solar field (SCA's, powerblocks, and perimeter fence) and overhead lines (n = 30 each or 120 total). Of these, only seven trials were not in easy visibility habitats, so visibility was not included as a covariate in the carcass removal models. Preliminary analysis using AICc suggested that both season and location (lines vs. solar field) were important predictors of carcass persistence, but when the data were separated by location, season was only important for carcasses within the solar field. Therefore, two carcass persistence models were fitted to two different sets of data: 60 carcasses total from spring and summer were used to estimate carcass persistence along overhead lines, and 30 carcasses total from summer only were used to estimate carcass persistence within the solar field.

Using carcass persistence data from 2015 spring and summer seasons as outlined above, survival models were compared for relative quality using the corrected AICc score, as suggested in Huso (2010). The AICc score provides a relative measure of model fit and parsimony among a selection of candidate models. The model with lowest AICc is typically chosen as the "best" model relative to other models tested; however, any model within two AICc points of the best model is considered competitive with the best model (Burnham and Anderson 2004).

For data collected at SCAs, the top two models had ΔAICc values <2. Ultimately, the loglogistic model that included an effect of carcass size was chosen as the most parsimonious of the top models. The chosen model predicted that 52% (45 – 64%) of small carcasses, 92% (76 – 96%) of medium carcasses, and 100% of large carcasses persisted for a standard 21-day search interval. Mean (median) removal time for small carcasses in the solar field was 8.0 (9.0) days, 35.1 (30.0) days for medium carcasses, and was not estimated for large carcasses given the nearly perfect persistence rate (no removal was observed; Figure 6).

For data collected along the overhead lines, the top six models had ∆AICc values <2. Ultimately the lognormal model with an effect of carcass size was chosen as the most parsimonious top model. The chosen model predicted that 14% (9 – 20%) of small carcasses, 59% (42 – 74%) of medium carcasses, and 41% (26 – 58%) of large carcasses persisted for a standard 21-day search interval. Mean (median) removal time along overhead lines for small carcasses was 0.8 (0.5) days, for medium carcasses was 12.8 (30.0) days, and for large carcasses was 4.6 (3.5) days (Figure 6). The difference in carcass removal times between Project components is because scavengers likely occur in higher densities outside the perimeter fence.

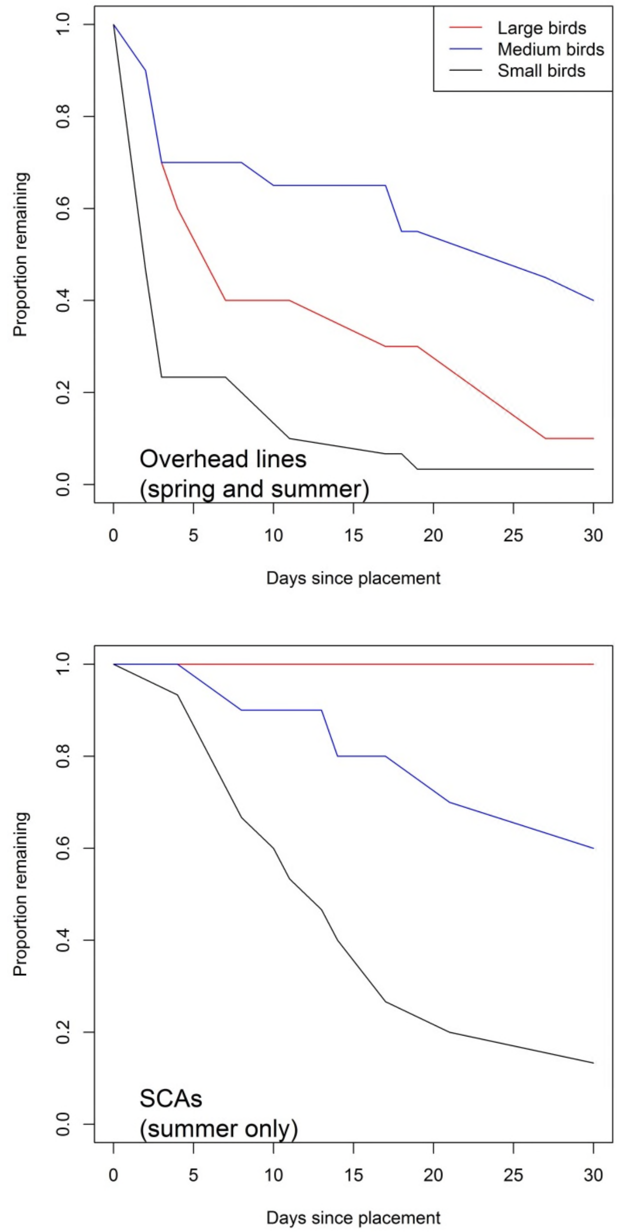

Figure 6. Proportion of trial carcasses remaining as a function of days since placement and carcass size class during the summer 2015 season at the Genesis Solar Energy Project, Riverside County, California. Modeling of carcass persistence data from overhead lines suggested no effect of season, so sample size used to produce the overhead lines panel was n = 30, 20, and 10 for small, medium, and large size classes, respectively. Modeling of carcass persistence data from the solar field (SCAs) suggested an effect of season, so sample size used to produce the SCA panel was n = 15, 10, and 5 for small, medium, and large size classes, respectively.

3.7 Searcher Efficiency Trials

During the 2015 summer season, a total of 60 searcher efficiency trials (30 small, 20 medium, and 10 large birds) were placed at the Project. Details regarding the number of searcher efficiency trial carcasses placed, removed, and available to be found by Project component are provided in Table 5. All carcasses removed by scavengers during searcher efficiency trials are assumed to have been removed before the observer had a chance to detect the trial carcass. Our analysis assumes the trial carcasses are removed at random and that the remaining carcasses provide a fair indication of our searcher efficiency.There was one observer at Genesis during summer; Sarah Nichols was tested throughout the summer season, and there were 51 trial carcasses available for her to find.

Table 5. Searcher efficiency trial carcass locations by Project component during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Placed	Removed	Available to be detected
Fence	6	4	2
Gen-tie line	15	1	14
Distribution line	15	1	14
Powerblocks	3	0	3
SCA’s	21	3	18
Total	60	9	51

In the solar field (SCAs + fence + powerblocks), the null model was chosen as the best model to estimate searcher efficiency, suggesting no effect of carcass size, season, or visibility class. Thus, data from spring and summer searcher efficiency trials, all carcass class sizes, and both visibility classes were pooled for the following estimate of searcher efficiency. Searcher efficiency rate in the solar field was 91.8% (86.0 – 98.0%), or 45 found of 49 available to be found.

Along overhead lines, the model that included an effect of carcass size, but not season or visibility class, was chosen as the best model. Thus, data from spring and summer trials and both visibility classes were pooled for the following estimates of searcher efficiency along overhead lines: 53.6% for small birds (39.0 – 68.0%; 15 found of 28 available to be found), 100% for medium birds (19 found of 19 available), and 100% for large birds (10 found of 10 available). Although carcass size influenced searcher efficiency, searcher efficiency was relatively high over all carcass size classes (77.1%).

3.8 Fatality Estimates

Fatality estimates were calculated separately for each component (SCAs, power blocks, fence, evaporation ponds, and overhead lines/road). Ultimately, no detection was excluded from the fatality analysis because it was estimated to be older than the 21-day search interval (Huso 2010). Of the 60 detections that occurred in summer, 16 were excluded from the summer fatality estimate because they were found outside standardized search areas, and 12 were excluded because they were found after the last standardized search in summer (to be included in fall 2015 estimates; Table 6, Appendix B).. However, all detections that occurred during summer are reported in Table 2. Detections used in the analysis, bias corrections, summer fatality estimates, and 90% confidence intervals for summer fatality estimates are detailed in Appendix B.

Table 6. Status of detections during the summer (June 01 – August 30) 2015 season at the Genesis Solar Energy Project, Riverside County, California. All detections outside the search area were excluded from the fatality analysis, regardless of whether they occurred during a standardized carcass search or incidentally.

	Carcass search	Incidental detection	*Pushed to next season's fatality estimate	*Pulled from previous season's fatality estimate
Inside search area	22	10	12	0
Outside search area	2	14	0	0

* Incidental detections occurring after the last standardized carcass search in a season are considered for inclusion in the fatality analysis for the following season. This is consistent with the assumption we make throughout the monitoring seasons; that carcasses found incidentally would have been available to be found on the next scheduled search. This assumption may result in some carcasses found during one season but considered in the following season's fatality analysis. Once a carcass has been moved to a different season's analysis it is still subject to the same criteria for inclusion or exclusion based on location (in versus out of a searched area) and carcass age (greater than versus less than the search interval).

Using the Huso (2010) fatality estimator model, during the summer period 2015, there were an estimated total 100 carcasses (90% CI: 81 - 145) at the Project. Of these, 53 carcasses (53%) were estimated for the SCAs, 8 carcasses (8%) were estimated for the fence, 9 carcasses (9%) were estimated for evaporation ponds, 23 carcasses (23%) were estimated for power blocks[1], and 7 carcasses (7%; CI: 6 – 21) were estimated for the overhead lines and project road. An estimated 93 (93%; CI: 66-126) carcasses (0.050/acre, (50/1000 acres, 0.37/nameplate MW)

[1] Estimate is based on adjusted mortality from the powerblock perimeter surveys and adding in the incidentals found by operations staff in the interior of the powerblock. The carcasses found by staff in the interior of the powerblock are not adjusted for biases because no trials are conducted in those areas (biologists are not allowed in that area for safety reasons). However, daily surveys are conducted throughout the interior of the powerblock by operations staff for equipment inspections, and several personnel spend time in those areas on a daily basis.

occurred for all components associated with both solar units (SCAs, power block, evaporation ponds, and along the perimeter fence, combined). A complete list of estimates for each Project component and carcass size class with confidence intervals is presented in Appendix B.

4.0 DISCUSSION

The 2015 summer season represented the second season of standardized monitoring at Genesis per the BBCS. Searcher efficiency trials and carcass removal trials were conducted concurrently at the SCAs, power blocks, fencelines, and along the gen-tie and distribution lines. Data from these trials were used to produce fatality estimates adjusted for searcher efficiency and carcass persistence bias. Although these estimates were produced from a statistically robust sample, only limited inference may be drawn from a single season of data. These results should be considered preliminary because estimating carcass persistence, searcher efficiency, and adjusted numbers of fatalities within each season represents information based on a limited sample size. As more data are collected throughout the monitoring year (and additional quality assurance/quality control measures occur, for example characterizing feather spots to species or size class), data from all seasons may be pooled. At that time, data will be tested for seasonal differences retrospectively using an information-theoretic approach, but because seasonal estimates will be produced from the much larger annual data set, they may differ from what is reported here because they are based on a larger, more informative sample.

4.1 Carcass Persistence and Searcher Efficiency Trials

The degree to which carcasses persist on the landscape depends on a variety of factors reflecting seasonal and inter-annual variation in habitat, climate, and the scavenger community. The composition and activity patterns of the scavenger community often vary seasonally as birds migrate, new juvenile birds and mammals join the local population, and mammalian scavengers variably hibernate or estivate. The scavenger community may also vary substantially from year to year because of variation in annual reproduction and survival related to changes in landscape condition. Climatic conditions that vary seasonally and annually also may contribute to variation in carcass decay and removal rates due to variation in temperatures, solar insolation, wind patterns, and the frequency of flooding events. Thus, rates of carcass persistence reported here should be interpreted cautiously as they may change over the coming months.

Fatality estimates are influenced by the relationship between carcass removal dynamics and search intervals. In practical terms, longer search intervals reduce average probability that a carcass persists until the next search. In terms of the analysis, this can manifest as a lower probability of persistence through the effective search interval, or an effective search interval that is shorter than the nominal search interval. In either case, the adjustment to carcass counts due to carcass removal dynamics is calculated as

$$\frac{\text{length of effective search interval}}{\text{length of nominal search interval} * \text{average probability of persistence through the effective search interval}}$$

The adjustment to estimated fatality for carcass removal increases with longer search intervals, and the variance in the estimate may increase, also.

Searcher efficiency was influenced by carcass size, but it is not yet clear if there may be an effect of habitat visibility class due to limited sample sizes. In the SCA's, searcher efficiency was high regardless of carcass size and this is likely influenced by the limited vegetation cover beneath solar troughs. Beneath overhead lines outside the Project fence vegetation cover is higher, but our analysis did not support the hypothesis that visibility class is a factor in searcher efficiency along the lines. Carcass size influenced searcher efficiency, but searcher efficiency was relatively high over all carcass size classes (77.1%).

Searcher efficiency trials for this Project will be repeated seasonally. The desert landscape in which this Project is located generally changes little with the seasons, save for brief periods following seasonal rains when floods may occur and blooming plants may flourish. A recent meta-analysis involving data from more than 70 wind-energy projects suggested that including habitat visibility class as a predictive variable generally eliminated any otherwise apparent seasonal effects on searcher efficiency (Smallwood 2013). Further, the possibility exists that searcher efficiency varies seasonally in some cover types but not others. Data from searcher efficiency trials conducted over the coming seasons will therefore continue to be tested for effects of habitat visibility class rather than effects of season.

4.2 Distribution of Fatalities and Fatality Estimates

The number of detections was highest during the early and late summer monitoring period and lowest during July. However, because this report includes detections made during carcass searches and incidental detections reported by Genesis site personnel between searches, patterns may reflect the 21-day search interval during summer more than any patterns in bird activity at the Project.

Composition of summer detections included avian species from 13 guilds. No single guild comprised a large number of detections: the most common was blackbirds/orioles (eight detections or 14.5% of all avian detections). Shorebirds and waterbirds/waterfowl were represented by six (10.9%) and seven (12.7%) detections, respectively. Summer was the first season in which bats were detected.

Detections attributed to an unknown cause accounted for approximately 30% of all detections during the 2015 summer season, and the distribution of the unknown cause detections varied by project component with the highest percentage of unknowns (66.7%, or 4 of 6 total detections) occurring in association with Project components that are not included in standardized carcass searches (e.g., buildings). Of the 18 detections attributed to an unknown cause, 4 (22.2%) were feather spots. Determining a cause of mortality from a feather spot is challenging because there is rarely visible evidence available on which to determine a cause of death. Thus, feather spots with an unknown cause of mortality could be encountered anywhere birds occur, and an unknown cause of a sizeable proportion of the carcasses is not unique to the Project. Further, game cameras trained on carcasses for carcass persistence trials at the Project have documented multiple feather spots originating from a single trial carcass. Ravens and turkey vultures, and possibly roadrunners, dislodge feathers from their attachment to the skin during the scavenging process. There are a very large number of potential feather spots present on a single bird carcass (because a feather spot is defined as at least two or more primary flight feathers, at least five or more tail feathers, or two primaries within five m (16.4 ft) or less of each other, or a total of 10 or more feathers of any type concentrated together in an area of three square m). Thus, the presence of feather spots among the detections for the Project may inflate the fatality estimate based on the potential for multiple feather spots resulting from one fatality to be counted separately if feathers are blown around the site or scattered by predators (e.g., plucking by ravens), feather spots resulting from predation not associated with the facility, or other causes. However, feather spots are included in the analysis here to provide a more conservative estimate of fatality.

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Appendix A. Weather Conditions and Body Weights Associated with Avian Detections Estimated to be Less Than 24 Hours Old during summer (June 01 – August 30) 2015

Table A-1. Weather conditions and body weights associated with avian detections estimated to be less than 24 hours old during summer 2015 at Genesis Solar Energy Project, Riverside County, California.

Carcass ID	Date	Estimated time since death (hrs)	Species	Weight (g)	Weather Summary for Preceding 24 hrs
081315-TRES-EVAPPOND-N-01	8/13/2015	8-24hrs	tree swallow	13	6-16 MPH SE wind, Temp 109F, waning crescent moon. Clear through 1pm 8/12, partly to mostly cloudy through 9pm, then clear.
061115-GRRO-GENTIE16-1	6/11/2015	8-24hrs	greater roadrunner	240	-
060915-ECDO-OMBUILDING-STAIRCASE-1	6/9/2015	0-8hrs	Eurasian collared-dove	150	-
062615-GRRO-1-W-G/H-62-01	6/26/2015	8-24hrs	greater roadrunner	165	AVG WIND SPD: 11MPH, MAX WIND SPD: 17MPH, WIND DIRECTION: SOUTH, CLEAR SKY, MOON PHASE: WANING GIBBOUS
062915-SNEG-2-POWERBLOCK-INSIDE-02	6/29/2015	8-24hrs	snowy egret	-	MAX WIND SPD. 17MPH, AVG WIND SPD: 8MPH, DIRECTION: S/SW, CONDITIONS: CLEAR WITH THUNDERSTORMS, MOON PHASE: WAXING GIBBOUS
062215-CAGU-1-E-C/D-53-1	6/22/2015	8-24hrs	California gull	350	HIGH TEMP: 107.1, LOW TEMP: 70.9, MAX WIND SPD: 8.3MPH, AVG WIND SPD: 7.6MPH, DIRECTION: SOUTH, CLEAR SKY, MOON PHASE: WAXING CRESENT
072915-LENI-GENTIE-13-01	7/29/2015	0-8hrs	lesser nighthawk	43	wind S @ 7-14 mph, waxing gibbous moon, clear, 10 mi visibility
081715-MODO-2-POWERBLOCK-02	8/17/2015	8-24hrs	mourning dove	-	9-21mph S wind. Waxing crescent moon, clear through 12 noon, partly to mostly cloudy through 11pm then clear
081715-MODO-GENTIE-17-01	8/17/2015	8-24hrs	mourning dove	-	9-21mph S wind, waxing crescent moon, clear through 12 noon, partly to mostly cloudy through 11pm, then clear
082815-BHCO-1-W-G/H-44-03	8/28/2015	8-24hrs	brown-headed cowbird	21	5-21MPH SSW wind, waxing gibbous moon, thunderstrom in the area
082215-UNBA-ADMINBUILDING-01	8/22/2015	0-8hrs	canyon bat	2	12-20 MPH S wind, waxing crescent moon, clear
082415-UNBA-ASSEMBLYLINEBUILDING-FREEZER-02	8/24/2015	8-24hrs	canyon bat	-	8-14 MPH S-SW wind, waxing gibbous moon, partly cloudy to clear to cloudy
082315-TOWA-2-POWERBLOCK-OVERFLOWPUMP-B-01	8/23/2015	8-24hrs	Townsend's warbler	6	12-20 S wind, temp 107, waxing crescent moon, clear until 1500, partly cloudy until 2000, then clear until bird found
082315-MODO-GENTIE-10-03	8/23/2015	8-24hrs	mourning dove	99	12-20mph S wind, temp 107, waxing crescent moon, clear until 1500,

082815-CITE-EVAPPOND-N-01	8/28/2015	8-24hrs	cinnamon teal	345	partly cloudy until 2000, then clear until bird found 5-21 mph SSW wind, waxing gibbous moon, thunderstorm in area

Appendix B. Correction Factors and Bird Fatality Rates at the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Table B-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during summer of 2015. *Counts of fatalities on the power block and ponds have no variance because all components at the facility were searched.

	Small birds		Medium birds		Large birds		Unknown size		Bats	
Parameter	**Mean**	**CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Proportion of area searched by component										
Overhead lines	0.25	-	0.25	-	0.25	-	0.25	-	0.25	-
Fence	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
SCAs	0.30	-	0.30	-	0.30	-	0.30	-	0.30	-
Powerblock[1]	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Ponds	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Searcher efficiency by component and visibility class										
Overhead lines	0.54	0.39 - 0.68	1.00	-	1.00	-	0.54	0.39 - 0.68	0.54	0.39 - 0.68
All other components	0.92	0.86 - 0.98	0.92	0.86 - 0.98	0.92	0.86 - 0.98	0.92	0.86 - 0.98	0.92	0.86 - 0.98
Average probability of carcass persistence to the next search										
Overhead lines	0.140	0.09 - 0.2	0.588	0.42 - 0.74	0.409	0.26 - 0.58	0.140	0.09 - 0.2	0.143	0.09 - 0.21
Fence	0.462	0.38 - 0.56	0.940	0.84 - 0.99	1	-	0.462	0.33 - 0.61	0.462	0.37 - 0.63
SCAs	0.520	0.45 - 0.64	0.925	0.76 - 0.96	1	-	0.520	0.34 - 0.6	0.520	0.37 - 0.63
Powerblock	0.504	0.4 - 0.56	0.851	0.79 - 0.9	1	-	0.504	0.33 - 0.58	0.504	0.41 - 0.56
Ponds	0.504	0.42 - 0.56	0.851	0.73 - 0.93	1	-	0.504	0.37 - 0.64	0.504	0.37 - 0.63
Carcass counts by component										
Overhead lines	0	-	1	0 - 3	0	-	0	-	0	-
Fence	2	0 - 6	1	0 - 3	0	-	1	0 - 3	0	-
SCAs	5	2 - 9	3	0 - 6	0	-	1	0 - 3	0	-
Powerblock*	3	-	6	-	0	-	1	-	3	-
Ponds*	3	-	2	-	0	-	0	-	0	-
Average Probability of Carcass Availability and Detected (Searcher efficiency * average probability of carcass persistence)										
Overhead lines	0.08	0.04 - 0.12	0.59	0.42 - 0.74	0.41	0.26 - 0.58	0.08	0.04 - 0.12	0.08	0.04 - 0.12
Fence	0.42	0.35 - 0.52	0.86	0.76 - 0.94	0.92	0.86 - 0.98	0.42	0.3 - 0.57	0.42	0.34 - 0.59
SCAs	0.48	0.41 - 0.59	0.85	0.69 - 0.9	0.92	0.86 - 0.98	0.48	0.31 - 0.56	0.48	0.34 - 0.59
Powerblock	0.46	0.36 - 0.52	0.78	0.71 - 0.86	0.92	0.86 - 0.98	0.46	0.3 - 0.54	0.46	0.37 - 0.52
Ponds	0.46	0.38 - 0.53	0.78	0.66 - 0.88	0.92	0.86 - 0.98	0.46	0.34 - 0.59	0.46	0.34 - 0.59
Adjusted Fatality Estimates (Fatalities /Season; values in italics are considered unreliable due to low counts of carcasses: carcass count / (proportion of area searched * average probability of carcass availability and detected))**										
Overhead lines	0	-	*6.81*	*5.62 - 21.03*	0	-	0	0	0	0

Table B-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during summer of 2015. *Counts of fatalities on the power block and ponds have no variance because all components at the facility were searched.

	Small birds		Medium birds		Large birds		Unknown size		Bats	
Parameter	**Mean**	**CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Fence	*4.72*	*3.92 - 14.57*	*1.16*	*1.07 - 3.61*	0	-	*2.36*	*1.85 - 8.26*	0	0
SCAs	*34.39*	*12.18 - 56.61*	*11.61*	*3.98 - 25.48*	0	-	*6.88*	*6.15 - 24.15*	0	0
Powerblock	*6.48*	*5.82 - 8.27*	7.67	7.01 - 8.49	0	-	*2.16*	*1.84 - 3.3*	*6.48*	*5.74 - 8.13*
Ponds	*6.48*	*5.82 - 8.27*	*2.56*	*2.34 - 2.83*	0	-	0	-	0	-

[1] Estimate is based on adjusted mortality from the powerblock perimeter surveys and adding in the incidentals found by operations staff in the interior of the powerblock. The carcasses found by staff in the interior of the powerblock are not adjusted for biases because no trials are conducted in those areas (biologists are not allowed in that area for safety reasons). However, daily surveys are conducted throughout the interior of the powerblock by operations staff for equipment inspections, and several personnel spend time in those areas on a daily basis.

Table B-2. Carcasses excluded from the summer 2015 fatality analysis at the Genesis Solar Energy Project.

Parameter	Small birds	Medium birds	Large birds	Unknown size	Bats
Buildings	3	1	0	0	2
Overhead lines	0	3	0	0	0
SCAs	3	3	1	0	0
Pond	0	3	0	0	0
Powerblock	6	3	0	0	0

Appendix C. Detailed Areas of Standardized Searches and Carcass Locations along the Distribution and Generation Tie Lines of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

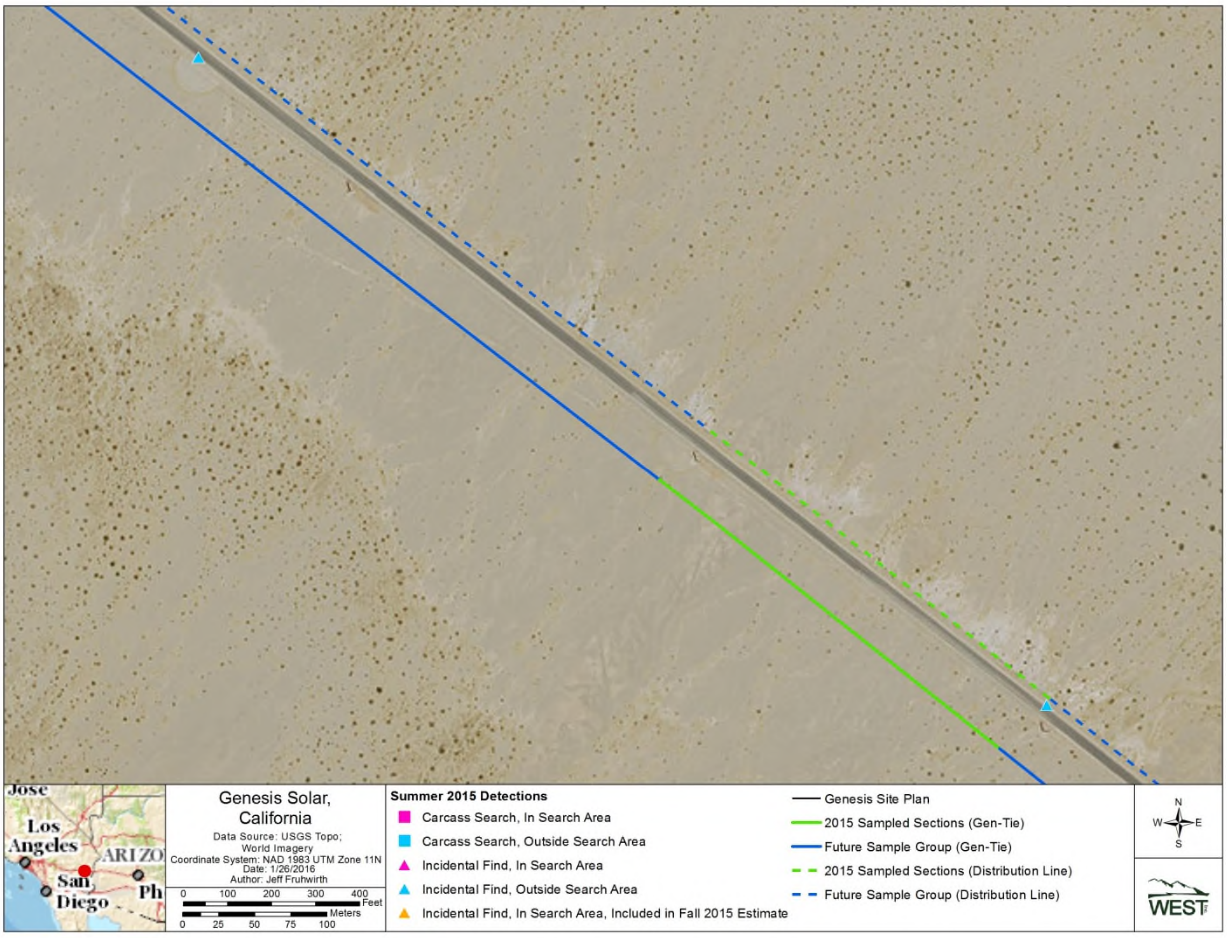

Figure C-1. Detailed map sections of detections along the distribution and generation tie lines of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Figure C-2. Detailed map sections of detections along the distribution and generation tie lines of the Genesis Solar Energy Project during summer (June 01 – August 30) 2015.

Appendix D. Individual detections made during standardized carcass searches and incidentally, by species, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector trough.

Table D-1. Number of individual detections (those made during standardized carcass searches and incidentally), by species, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector trough.

Common Name	Scientific Name	Migration Behavior*	Guild	Count	Project Component
American kestrel	*Falco sparverius*	resident	Falcons	1	Powerblock
bank swallow	*Riparia riparia*	diurnal	Swallows	1	Powerblock
belted kingfisher	*Ceryle alcyon*	nocturnal	Kingfishers	1	Powerblock
black phoebe	*Sayornis nigricans*	variable	Flycatchers	1	Powerblock
brown-headed cowbird	*Molothrus ater*	diurnal	Blackbirds/Orioles	1	Other
				2	Powerblock
				2	SCA
California gull	*Larus californicus*	diurnal	Shorebirds	1	SCA
canyon bat	*Pipistrellus hesperus*	nocturnal	Bats	2	Other
cinnamon teal	*Anas cyanoptera*	nocturnal	Waterbirds/Waterfowl	1	Pond
				1	SCA
cliff swallow	*Petrochelidon pyrrhonota*	diurnal	Swallows	1	Powerblock
common nighthawk	*Chordeiles minor*	variable	Goatsuckers	1	Pond
eared grebe	*Podiceps nigricollis*	nocturnal	Waterbirds/Waterfowl	1	Pond
Eurasian collared-dove	*Streptopelia decaocto*	resident	Doves/Pigeons	1	Other
Gambel's quail	*Callipepla gambelii*	resident	Upland Game Birds	1	Fence
greater roadrunner	*Geococcyx californianus*	resident	Cuckoos	1	Overhead lines
				3	Powerblock
				1	SCA
lesser nighthawk	*Chordeiles acutipennis*	diurnal	Goatsuckers	1	Overhead lines
loggerhead shrike	*Lanius ludovicianus*	diurnal	Shrikes	1	SCA
long-billed curlew	*Numenius americanus*	nocturnal	Shorebirds	1	SCA
Mexican free-tailed bat	*Tadarida brasiliensis*	nocturnal	Bats	1	Powerblock
mourning dove	*Zenaida macroura*	variable	Doves/Pigeons	2	Overhead lines
				1	Powerblock
red-winged blackbird	Agelaius phoeniceus	diurnal	Blackbirds/Orioles	1	Fence
				1	SCA
ruddy duck	*Oxyura jamaicensis*	nocturnal	Waterbirds/Waterfowl	1	Pond

Table D-1. Number of individual detections (those made during standardized carcass searches and incidentally), by species, during summer (June 01 – August 30) 2015 at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector trough.

Common Name	Scientific Name	Migration Behavior*	Guild	Count	Project Component
snowy egret	*Egretta thula*	nocturnal	Waterbirds/Waterfowl	1	Powerblock
spotted sandpiper	*Actitis macularia*	both	Shorebirds	1	SCA
Townsend's warbler	*Setophaga townsendi*	unresolved	Warblers	1	Powerblock
tree swallow	*Tachycineta bicolor*	diurnal	Swallows	1	Pond
unidentified bat	-	-	Bats	2	Powerblock
unidentified bird (medium)	-	-	Unidentified Birds	1	Pond
unidentified bird (small)	-	-	Unidentified Birds	1	Fence
				1	Powerblock
				3	SCA
unidentified bird (unknown size)	-	-	Unidentified Birds	1	Fence
				1	Powerblock
				1	SCA
unidentified duck	-	-	Waterbirds/Waterfowl	2	SCA
unidentified sandpiper	-	-	Shorebirds	1	Powerblock
western gull	*Larus occidentalis*	resident	Shorebirds	1	SCA
western kingbird	*Tyrannus verticalis*	diurnal	Flycatchers	1	Other
western sandpiper	*Calidris mauri*	both	Shorebirds	1	Pond
white-winged dove	*Zenaida asiatica*	variable	Doves/Pigeons	2	Powerblock
yellow-billed cuckoo	*Coccyzus americanus*	nocturnal	Cuckoos	1	Powerblock
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	diurnal	Blackbirds/Orioles	1	Pond
yellow warbler	*Setophaga petechia*	nocturnal	Warblers	1	Other
Total				**60**	

* See literature cited for migration behavior references; information for most species was taken from the respective species accounts found in Birds of North America (BNA) Online (http://bna.birds.cornell.edu/bna/); where information on migration behavior was lacking in BNA accounts, Evans and Mellinger (1999), Newton (2008), or Murray (2004) were used.